IMPROVED BICOMPONENT FILAMENT SPIN PACK USED IN SPUNBOND PRODUCTION

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an apparatus and method used in spunbond production for making spunbond fabrics or laminates composed of bicomponent filaments, and specifically to an improved spin pack that insures accurate and even flow of the bicomponent melt streams to achieve a high uniformity of the fabric in both thickness and basis weight produced.

2. Description of The Prior Art

The production of spunbond filaments made up of two different polymers for a single filament is well known in the art. Various types of bicomponent filaments made up of two different polymers are known. Sheath/core, side-by-side, pie-shaped segments, and island in the sea are examples of the cross section of the two different polymers employed.

The production of bicomponent filaments requires a special spin pack capable of delivering two (2) distinctively different polymer melts separately (without mixing) until the merging of the two different polymer melt streams. Typically the

bicomponent polymer merge occurs at the entrance of the spinneret orifices that result in a plurality of filaments (one bicomponent filament per orifice) produced with the desired configuration and ratio of the filament cross section having two different polymer components. The amount of material or ratio in volume of material of two different polymer components can range from 10/90 to 90/10.

A bicomponent spin pack is not new in the industry of filament and staple fiber production wherein the spin pack often possesses a round shape of less than five hundred millimeters in diameter with a small number of filament forming orifices or holes. Alternatively, in some cases the spin pack can have a rectangular shape with a small length-to-width ratio of less than two.

New requirements in the spunbond industry seek a high ratio of spin pack length verses width (up to forty or higher) and a large number of filament forming orifices (up to six thousand per meter width or higher). Difficulties at this spin pack size arise from the physical requirement of even distribution of two different bicomponent polymer melts, especially in the pack longitudinal direction, which is key to producing high quality spunbond fabrics with uniformity and thickness and basis weight. U.S. Patent 4,251,200 issued to Parkin, February 17, 1981 describes an apparatus for spinning bicomponent filaments. A

similar device is shown in the same inventors U.S. Patent 4,293,516, issued October 6, 1981 which is the Process of Spinning Bicomponent Filaments. These patents show a single distribution plate for the two separate polymer melt streams. U.S. Patent 5,505,889 issued to Davies April 9, 1996 shows a method of spinning bicomponent filament. Again a single distribution plate is employed. U.S. 5,948,528 issued to Helms et al., September 7, 1999 shows a process for modifying synthetic bicomponent fiber cross sections and bicomponent fibers hereby produced.

In providing a high ratio of pack length versus width, up to 40 or higher, with the large number of holes in the spinneret, up to 6,000 per meter width or higher (up to 10,000), difficulties arise in even distribution of the polymer. This is especially true in the longitudinal direction of the spin pack, which is key to producing high-quality spunbond fabrics with uniformity in thickness and basis weight when using bicomponents.

One of the purposes of the present invention is to provide for even distribution of two different polymer melts in a high ratio of pack length versus width (up to 40 or higher) with a large number of holes.

In order to insure that the molten polymers for both polymer A and polymer B in a bicomponent filament achieve the

proper uniformity, there must be uniform pressure applied to the melt flow from the spin pack housing chambers, there being separate, independent chambers for polymer A and polymer B. The polymers A and B under pressure do not come together until the polymers reach the entrance to the spinneret to form a bicomponent filament. One of the important aspects of the present invention is to maintain a uniform and consistent pressure on each molten polymer A and polymer B as each progresses from its introduction into the spin pack and its distribution through the distribution plates to each spinneret hole.

Heretofore, the spin packs have been relatively short in length to afford uniform pressure distribution of the molten polymer as it is introduced under pressure and forced under pressure through the spin pack into the spinneret. However, as attempts to make the entire spin pack assembly much larger to accommodate increasing greatly the number of filaments produced, the present invention provides for elongated spin pack assemblies that can even achieve ratios of 40 to 1 in length versus width, and spinneret holes above 6,000 per meter. This is accomplished by controlling and maintaining a uniform pressure on the polymer in each separate chamber and each separate flow path by the use of a polymer diversion frame mounted within each spin pack housing chamber.

The diversion spin pack is an enlarged body mounted within each spin pack housing chamber that receives the molten polymer from an inlet source. The diversion frame is mounted longitudinally along the entire length of the spin pack housing chamber and may be supported approximately halfway up in the housing chamber, which includes a roof portion that is substantially shaped in a tapered manner, much like the upper portion of a coat hanger, giving it the term "coat hanger." The upper portion of the diversion frame may also be likewise shaped to form a uniform chamber within a chamber. The diversion frame is also narrower in width than the spin pack housing chamber so that there are spaces formed (on each side) between the diversion frame body, which occupies a significant volume of the spin pack chamber, and both inside walls of the spin pack chamber so that the molten polymer under pressure is forced down along the chamber and diversion frame side walls vertically to the base of the spin pack housing and the base of the diversion frame. The bottom portion of the spin pack housing is in fluid communication with a screen that is used to filter the polymers at their introduction into the distribution plates. The lower base portion of each diversion frame has a tapered segment running along its entire length on both sides to allow the full volume of molten polymer which is being forced under pressure down along the chamber side walls to be forced under pressure

uniformly over the top portion of the filter screen throughout the entire length of the spin pack housing and the housing chamber. Because of the volume occupied by the diversion frame and its unique shape, including its tapered base, and the thickness or width of the diversion chamber, leaving small side spaces running the entire length of the spin pack housing chamber on both sides, sufficient uniform and constant pressure can be maintained on the polymer after its introduction under pressure into the spin pack housing chamber throughout the entire length of the spin pack assembly, allowing for greatly increased distances of construction of the spin pack assembly and allowing for ratios of 40 to 1, length to width, and greatly increasing the number of spinneret apertures that can be serviced while providing still a uniform pressure on each polymer, polymer A and polymer B, throughout the entire flow path until it reaches the spinneret opening. By providing for uniform and consistent pressures throughout for both polymers, a consistent uniform filament composed of two separate components and two separate polymers is created. Temperatures and flow volumes of the polymers should also remain uniform.

Another important aspect of the present invention is to provide a modular structure of the spin pack (around 600 millimeters width each) which also can result in the manufacture of large length spin packs (up to 6 meters).

The present invention incorporates a pair of diversion frames, one beneath each coat hanger-shaped chamber, using two different bicomponent polymer melts. The invention also includes a metering plate and filter screen for each melt to insure accurate and even flow of the two bicomponent melt streams, achieving very high uniformity of the fabrics produced.

BRIEF SUMMARY OF THE INVENTION

An improved bicomponent filament spin pack used in spunbond production for constructing spunbond fabrics or laminates that are composed of two different polymers in each filament comprising a spinneret, feeder block for each polymer, a spin pack housing, a coat hanger, and one or more distribution plates for distributing two separate streams of polymer melts that are the bicomponents of the filaments to the spinneret.

The spin pack assembly also includes a metering plate, a filter screen, and a screen support plate.

The spin pack housing is mounted on top of the metering plate which sits on top of one or more distribution plates mounted on top of the spinneret. The distribution plates and the metering plate have a plurality of passages that are aligned through each distribution layer so that the spinneret apertures receive two separate molten polymers in such a configuration that, for example, form a sheath/core filament that is extruded

through the spinneret orifices. In this case, each spinneret orifice will produce a bicomponent filament that has an inner core of one polymer and a surrounding cylindrical sheath that surrounds the inner core with a second polymer.

The spin pack housing includes two separate longitudinal chambers (one for each polymer) that are separated from each other. Each chamber has a coat hangar segment that receives a polymer. Within each spin pack housing chamber is a diversion frame that sits on top of a filtered screen that is mounted on top of a screen support plate that includes a plurality of passages through the screen support plate. The diversion frame is a solid block of material that has a cross section that includes a truncated trapezoid at its base so that the base is adjustable shorter or narrower than the top surface. The diversion frame is sized within each coat hanger to force the polymer around its sides and downwardly, but permitting inward polymer flow onto a filter screen. The purpose of the diversion frame and the filter screen is to provide for uniform distribution of each polymer over a metering plate that also includes a plurality of feed apertures which lead to the distribution plates. By using a diversion frame in conjunction with the metering plate and a filter screen, the present invention is able to use large length spin packs, up to 6 meters, and accommodate a high ratio of pack versus width (up to

40 or higher), with a large number of holes of up to 6,000 per meter width or higher being required. The invention allows for high quality spunbond fabrics with even distribution of the polymer melts in a longitudinal direction to produce fabrics with uniformity in thickness and basis weight.

Thus the two chambers and coat hangars provided in the spin pack housing is used to house the different polymers used to form the bicomponent filaments in accordance with the invention. For example housing chamber A would utilize a first polymer which is received inside the spin pack housing and which flows on top of and around a diversion frame in chamber A. Like wise chamber B which is also a separate chamber in the spin pack housing receives a different polymer.

A polymer bicomponent feeder block is mounted on top of the spin pack housing. The bicomponent polymer feeder block maintains a plurality of independent channels that allows polymer A to be fed into chamber A located in the spin pack housing and polymer B to be fed into chamber B located in the spin pack housing.

In operation, polymer A is supplied to the chamber A in the spin pack housing through the feeder block as is polymer B provided to chamber B in the spin pack housing. Melted polymer A is then dispersed around the diversion frame through the filter screen into the metering plate and through the first,

second, and third distribution plates. Polymer A maintains its own separate path until polymer A reaches the spinneret apertures. Polymer B also after being received into chamber B in the housing is dispersed around the diversion frame onto the filter screen through the screen support plate, the metering plate, and the distribution plates, arriving in a separate path at the spinneret hole. Just above the spinneret hole the two streams come together so that there is a center component of polymer A and an external or circular component of polymer B being extruded through each spinneret orifice in a sheath/core type filament of the bicomponents for polymer A and polymer B.

It is an object of this invention to provide an improved bicomponent filaments spin pack for creating spunbond fabrics with filaments that have two components of different polymers.

It is another object of this invention to provide an improved bicomponent filaments spin pack that provides for even distribution of both polymer melts especially in a longitudinal direction to produce high quality spunbond fabrics with uniformity and thickness and basis weight.

But yet still another object of the invention is to provide an improved spin pack of modular structure that is approximately six hundred millimeters wide and up to six meters in length that achieves high uniformity and accurate and even flow of the melt.

In accordance with these and other objects which will become apparent hereinafter, the instant invention will now be described with particular reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 shows a perspective view, partially cut away, of a spin pack in accordance with the present invention.

Figure 2 shows a side elevational view in cross section of the present invention.

Figure 3 shows a top plan view of a spin pack in accordance with the present invention.

Figure 4 shows a side elevational view of a feeder block used with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to Figure 1, a spin pack assembly 10 in accordance with the present invention is shown mounted on spinneret 12. Spinneret 12 includes a plurality of filament-forming apertures 12a which receive both polymer A and polymer B for forming bicomponent filaments.

The spin pack assembly includes an elongated housing 32 that has chambers 36 and 34 for receiving polymer A and polymer B, respectively. The spin pack housing 32 is mounted on aluminum

gasket 28 which separates it from the metering plate 22. Screen support plates 24 and 42 are mounted on the metering plate 22. The metering plate 22 provides two separate chambers that include two individual screens 26 and 40 supported on screen support plates 24 and 42, respectively. The spin pack assembly housing 32 also has two separate chambers 34 and 36. Polymer A is in chamber 36 and includes a diversion frame 38 that rests on screen 40. In a separate chamber 34, a diversion frame 30 is provided that rests on screen 26.

The spin pack assembly also includes three separate distribution plates 14, 16, and 20 that are stacked on top of each other and include a plurality of apertures that distribute polymer A and polymer B to the spinneret holes.

Diversion frame 38 is a solid block of material that includes a tapered bottom portion, much like a truncated trapezoid, and an upper rectangular portion. Polymer A is received into chamber 36 in housing 32 and in its molten form will be diverted around the sides of the diversion frame, ultimately residing on screen 40 and screen support plate 42, where it is transferred to passages 22a which are used for metering the different polymers.

Referring now to Figure 2, the present invention is shown disclosing the coat hanger chamber 34 that houses polymer B in conjunction with the diversion frame 30 mounted therein. This

drawing also shows the stacked arrangement between the spinneret 12 and the three distribution plates 14, 16, and 20. Element 22 is the metering plate.

Figure 2 also shows feeder blocks 50 and 52 as mounted on top of spin pack housing 32 which includes channel inlets for polymer A and polymer B into each of the separate chambers for polymer A and polymer B as shown in Figure 1.

Figure 3 shows the top plan view of the feed elements on top of the housing 32.

Figure 4 shows a side elevational view with one of the feeder blocks 50 as it is mounted on top of housing 32.

Referring back to Figure 1, in operation, polymer B is fed into chamber 34 where it is distributed over the diversion frame 30 and through screen 28, screen support 24, through apertures 24a into the metering plate 22. The metering plate, for example, shows a plurality of channels 22a that are used to feed polymer B down to the third distribution plate 20. The molten polymer B will be passed through the distribution plates 20, 16, and 14 until it is received into apertures 12a in spinneret 12. A similar flow sequence is provided for polymer A around diversion frame 38 through screen 40 and screen support plate 42 and aperture 42a into the metering block 22. A separate set of passages not shown will allow polymer A to flow to distribution plate 20 and subsequently through distribution plates 16 and 14,

ultimately arriving also at the spinneret aperture 12a. The two materials, polymer A and polymer B, come together in aperture 12a and form a bicomponent filament.

By using a diversion frame, such as 30 and 38, in conjunction with screens 28 and 40 and screen support plates 24 and 42 in conjunction with the metering plate 22, applicant's spin pack can increase the ratio of pack length versus width, up to 40 or higher, with a large number of filament holes, up to 6,000 per meter width. This results in a modular spin pack structure of 600 millimeters wide and allows for the design of a large length spin pack, up to 6 meters, which can be readily accomplished. Using the present invention, uniform distribution of both polymer melts is achieved, especially in the longitudinal direction, which is key to producing high-quality spunbond fabrics with uniformity in thickness and basis weight.

The invention can also be used with a single polymer to accomplish greater uniform distribution of a single polymer as described herein.

The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment. It is recognized, however, that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.